

frivol

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# Chapter 1

## Class Index

### 1.1 Class Hierarchy

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## Chapter 2

# Class Index

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## Chapter 3

# Class Documentation

### 3.1 `frivol::fortune::Algorithm< PolicyT >` Class Template Reference

```
#include <algorithm.hpp>
```

#### Classes

- struct **EventPriority**  
*Priority of events in the event queue.*

#### Public Types

- typedef `PolicyT::Coord` **CoordT**
- typedef `Point< CoordT >` **PointT**
- typedef `VoronoiDiagram< CoordT >` **VoronoiDiagramT**

#### Public Member Functions

- `Algorithm` (const `containers::Array< PointT >` &sites)
- void `step` ()  
*Runs the algorithm one event handling forward.*
- `CoordT` `getSweepLineY` () const
- bool `isFinished` ()  
*Returns true if the algorithm has finished.*
- void `finish` ()  
*Steps the algorithm until the end.*
- int `getVoronoiVertexCount` () const  
*Returns the number of Voronoi vertices met in the algorithm.*
- const `VoronoiDiagramT` & `getVoronoiDiagram` () const

#### Static Public Member Functions

- static `VoronoiDiagramT` `extractVoronoiDiagram` (`Algorithm< PolicyT >` &&algorithm)

### 3.1.1 Detailed Description

```
template<typename PolicyT = DefaultPolicy>class frivol::fortune::Algorithm< PolicyT >
```

State of Fortune's algorithm.

#### Template Parameters

<i>PolicyT</i>	The algorithm policy to use, instance of <a href="#">Policy</a> template.
----------------	---

### 3.1.2 Constructor & Destructor Documentation

3.1.2.1 `template<typename PolicyT > frivol::fortune::Algorithm< PolicyT >::Algorithm ( const containers::Array< PointT > & sites )`

Constructs algorithm state.

#### Parameters

<i>points</i>	Reference to the input set of sites. The object must exist throughout the existence of the <a href="#">Algorithm</a> .
---------------	--

### 3.1.3 Member Function Documentation

3.1.3.1 `template<typename PolicyT > VoronoiDiagram< typename PolicyT::Coord > frivol::fortune::Algorithm< PolicyT >::extractVoronoiDiagram ( Algorithm< PolicyT > && algorithm ) [static]`

Moves the Voronoi diagram from the algorithm state.

#### Parameters

<i>algorithm</i>	The algorithm state rvalue from which to move the Voronoi diagram.
------------------	--

3.1.3.2 `template<typename PolicyT > PolicyT::Coord frivol::fortune::Algorithm< PolicyT >::getSweepY ( ) const`

Returns the sweepline Y coordinate of last [step\(\)](#). Undefined return value if [step\(\)](#) has not been called yet.

3.1.3.3 `template<typename PolicyT > const VoronoiDiagram< typename PolicyT::Coord > & frivol::fortune::Algorithm< PolicyT >::getVoronoiDiagram ( ) const`

Returns the Voronoi diagram constructed in the algorithm. The diagram is complete if the algorithm is finished.

The documentation for this class was generated from the following files:

- /home/topi/coodaus/emscripten\_share/frivol/frivol/fortune/algorithm.hpp
- /home/topi/coodaus/emscripten\_share/frivol/frivol/fortune/algorithm\_impl.hpp

## 3.2 frivol::fortune::Arc Struct Reference

Information of an arc in [BeachLine](#).

```
#include <beach_line.hpp>
```

## Public Attributes

- Idx [site](#)  
*The index of the site from which the arc originates.*
- Idx [arc\\_id](#)  
*The ID of the arc.*

The documentation for this struct was generated from the following file:

- /home/topi/coodaus/emscripten\_share/frivol/frivol/fortune/beach\_line.hpp

## 3.3 frivol::containers::Array< T > Class Template Reference

```
#include <array.hpp>
```

## Public Member Functions

- [Array](#) ()  
*Creates an array with size 0.*
- [Array](#) (Idx size)
- Idx [getSize](#) () const  
*Returns the size of the array.*
- void [resize](#) (Idx size)
- const T & [operator\[\]](#) (Idx index) const
- T & [operator\[\]](#) (Idx index)

### 3.3.1 Detailed Description

```
template<typename T>class frivol::containers::Array< T >
```

Simple fixed-size array.

#### Template Parameters

<i>T</i>	The type of stored elements. Should be default constructible.
----------	---

### 3.3.2 Constructor & Destructor Documentation

3.3.2.1 `template<typename T > frivol::containers::Array< T >::Array ( Idx size )`

Creates an array with all elements default-constructed.

#### Parameters

<i>size</i>	The size of the array.
-------------	------------------------

### 3.3.3 Member Function Documentation

### 3.3.3.1 `template<typename T > const T & frivol::containers::Array< T >::operator[] ( Idx index ) const`

Returns reference to an element in the array.

#### Parameters

<i>index</i>	The zero-based index of the element.
--------------	--------------------------------------

#### Exceptions

<i>std::out_of_range</i>	if FRIVOL_ARRAY_BOUNDS_CHECKING is defined and 'index' overflows.
--------------------------	---

### 3.3.3.2 `template<typename T > T & frivol::containers::Array< T >::operator[] ( Idx index )`

Returns reference to an element in the array.

#### Parameters

<i>index</i>	The zero-based index of the element.
--------------	--------------------------------------

#### Exceptions

<i>std::out_of_range</i>	if FRIVOL_ARRAY_BOUNDS_CHECKING is defined and 'index' overflows.
--------------------------	---

### 3.3.3.3 `template<typename T > void frivol::containers::Array< T >::resize ( Idx size )`

Resizes the array to size. If size decreases the extra elements are removed. If size increases, the new elements are default-constructed. The operation may assign the current elements to a new place, and therefore pointers to the array may be invalidated.

#### Parameters

<i>size</i>	The new size.
-------------	---------------

The documentation for this class was generated from the following files:

- /home/topi/coodaus/emscripten\_share/frivol/frivol/containers/array.hpp
- /home/topi/coodaus/emscripten\_share/frivol/frivol/containers/array\_impl.hpp

## 3.4 `frivol::containers::search_trees::AVLLiterator< ElementT >` Class Template Reference

```
#include <avl_tree.hpp>
```

### Public Types

- typedef ElementT **value\_type**
- typedef ElementT \* **pointer**
- typedef ElementT & **reference**
- typedef ptrdiff\_t **difference\_type**
- typedef  
std::bidirectional\_iterator\_tag **iterator\_category**

## Public Member Functions

- [AVLIterator](#) ()  
*Constructs an invalid iterator.*
- bool **operator==** (const [AVLIterator](#)< ElementT > &other) const
- bool **operator!=** (const [AVLIterator](#)< ElementT > &other) const
- ElementT & **operator\*** ()
- ElementT \* **operator->** ()
- [AVLIterator](#)< ElementT > & **operator++** ()
- [AVLIterator](#)< ElementT > & **operator--** ()
- [AVLIterator](#)< ElementT > **operator++** (int)
- [AVLIterator](#)< ElementT > **operator--** (int)

## Friends

- class **AVLTree**< **ElementT** >

### 3.4.1 Detailed Description

template<typename ElementT>class frivol::containers::search\_trees::AVLIterator< ElementT >

Standard bidirectional iterator for iterating over the elements of an [AVLTree](#).

#### Template Parameters

<i>ElementT</i>	Type of elements stored in the search tree.
-----------------	---

The documentation for this class was generated from the following files:

- /home/topi/coodaus/emscripten\_share/frivol/frivol/containers/search\_trees/avl\_tree.hpp
- /home/topi/coodaus/emscripten\_share/frivol/frivol/containers/search\_trees/avl\_tree\_impl.hpp

## 3.5 frivol::containers::search\_trees::AVLNode< ElementT > Class Template Reference

```
#include <avl_node.hpp>
```

## Public Types

- typedef [AVLNode](#)< ElementT > **Node**

## Public Member Functions

- [AVLNode](#) (const ElementT &element)  
*Constructs an AVL root node with no children.*
- ElementT & [getElement](#) ()  
*Returns reference to the element stored in the node.*
- [Node](#) \* [createLeftChild](#) (const ElementT &element)
- [Node](#) \* [createRightChild](#) (const ElementT &element)
- bool [remove](#) (std::unique\_ptr< [Node](#) > &root\_ptr)
- [Node](#) \* [getLeftChild](#) ()  
*Returns pointer to the left child or nullptr if none.*

- `Node * getRightChild ()`  
*Returns pointer to the right child or nullptr if none.*
- `Node * getParent ()`  
*Returns pointer to the parent node or nullptr if this is the root.*
- `Idx getHeight () const`
- `Node * getLeftmostDescendant ()`  
*Returns the in-order leftmost node in the subtree from this node.*
- `Node * getRightmostDescendant ()`  
*Returns the in-order rightmost node in the subtree from this node.*
- `Node * getPreviousNode ()`
- `Node * getNextNode ()`
- `int getBalanceFactor ()`
- `void rotateRight (std::unique_ptr< Node > &root_ptr)`
- `void rotateLeft (std::unique_ptr< Node > &root_ptr)`

### Static Public Member Functions

- static void `swapNodes (Node *node1, Node *node2, std::unique_ptr< Node > &root_ptr)`

### 3.5.1 Detailed Description

`template<typename ElementT>class frivol::containers::search_trees::AVLNode< ElementT >`

AVL tree node. Nodes form a rooted binary tree.

#### Template Parameters

<i>ElementT</i>	The element type stored in the nodes.
-----------------	---------------------------------------

### 3.5.2 Member Function Documentation

**3.5.2.1** `template<typename ElementT > AVLNode< ElementT > * frivol::containers::search_trees::AVLNode< ElementT >::createLeftChild ( const ElementT & element )`

Create a new node and place it as the left child of this node.

#### Parameters

<i>element</i>	The element stored in the new node.
----------------	-------------------------------------

#### Returns

pointer to the added node.

**3.5.2.2** `template<typename ElementT > AVLNode< ElementT > * frivol::containers::search_trees::AVLNode< ElementT >::createRightChild ( const ElementT & element )`

Create a new node and place it as the right child of this node.

#### Parameters

<i>element</i>	The element stored in the new node.
----------------	-------------------------------------



**Returns**

pointer to the added node.

**3.5.2.3** `template<typename ElementT > int frivol::containers::search_trees::AVLNode< ElementT >::getBalanceFactor ( )`

Returns the balance factor of the node, i.e. difference of the heights of the subtrees from the left node and the right node. Empty subtree has height 0.

**3.5.2.4** `template<typename ElementT > Idx frivol::containers::search_trees::AVLNode< ElementT >::getHeight ( ) const`

Returns the height of the subtree from this node, including this node (leaf nodes have subtree height 1).

**3.5.2.5** `template<typename ElementT > AVLNode< ElementT > * frivol::containers::search_trees::AVLNode< ElementT >::getNextNode ( )`

Returns the in-order next node in the tree, or nullptr if the node is the rightmost.

**3.5.2.6** `template<typename ElementT > AVLNode< ElementT > * frivol::containers::search_trees::AVLNode< ElementT >::getPreviousNode ( )`

Returns the in-order previous node in the tree, or nullptr if the node is the leftmost.

**3.5.2.7** `template<typename ElementT > bool frivol::containers::search_trees::AVLNode< ElementT >::remove ( std::unique_ptr< Node > & root_ptr )`

Remove the node from the tree if it has at most one child. It will be replaced by the child.

**Parameters**

<i>root_ptr</i>	This unique pointer should own the root node of the tree, and will be set to the new root if the root changes.
-----------------	--

**Returns**

true if the node was removed, false if the node had both children.

**3.5.2.8** `template<typename ElementT > void frivol::containers::search_trees::AVLNode< ElementT >::rotateLeft ( std::unique_ptr< Node > & root_ptr )`

Perform left-rotation rooted in this node. Assumes that the node has a right child.

**Parameters**

<i>root_ptr</i>	This unique pointer should own the root node of the tree, and will be set to the new root if the root changes.
-----------------	--

**3.5.2.9** `template<typename ElementT > void frivol::containers::search_trees::AVLNode< ElementT >::rotateRight ( std::unique_ptr< Node > & root_ptr )`

Perform right-rotation rooted in this node. Assumes that the node has a left child.

#### Parameters

<i>root_ptr</i>	This unique pointer should own the root node of the tree, and will be set to the new root if the root changes.
-----------------	--

**3.5.2.10** `template<typename ElementT > void frivol::containers::search_trees::AVLNode< ElementT >::swapNodes ( Node * node1, Node * node2, std::unique_ptr< Node > & root_ptr ) [static]`

Swap the positions of two nodes in the tree.

#### Parameters

<i>node1,node2</i>	Pointers to the nodes to swap.
<i>root_ptr</i>	This unique pointer should own the root node of the tree, and will be set to the new root if the root changes.

The documentation for this class was generated from the following files:

- /home/topi/coodaus/emscripten\_share/frivol/frivol/containers/search\_trees/avl\_node.hpp
- /home/topi/coodaus/emscripten\_share/frivol/frivol/containers/search\_trees/avl\_node\_impl.hpp

## 3.6 frivol::containers::search\_trees::AVLTree< ElementT > Class Template Reference

```
#include <avl_tree.hpp>
```

### Public Types

- typedef [AVLIterator](#)< ElementT > **Iterator**

### Public Member Functions

- bool **empty** () const
- [Iterator](#) **begin** ()
- [Iterator](#) **end** ()
- template<typename FuncT > [Iterator](#) **search** (FuncT func)
- void **erase** ([Iterator](#) iter)
- [Iterator](#) **insert** ([Iterator](#) iter, const ElementT &element)

### 3.6.1 Detailed Description

```
template<typename ElementT>class frivol::containers::search_trees::AVLTree< ElementT >
```

Implementation of [SearchTreeConcept](#) using AVL tree. TODO: implement balacing

#### Template Parameters

<i>ElementT</i>	Type of elements stored in the search tree.
-----------------	---

The documentation for this class was generated from the following files:

- /home/topi/coodaus/emscripten\_share/frivol/frivol/containers/search\_trees/avl\_tree.hpp
- /home/topi/coodaus/emscripten\_share/frivol/frivol/containers/search\_trees/avl\_tree\_impl.hpp

## 3.7 frivol::fortune::BeachLine< PolicyT > Class Template Reference

```
#include <beach_line.hpp>
```

### Public Types

- typedef PolicyT::Coord **CoordT**
- typedef [Point](#)< CoordT > **PointT**

### Public Member Functions

- [BeachLine](#) (const [containers::Array](#)< [PointT](#) > &sites, Idx max\_arcs)
- Idx [getMaxArcCount](#) () const
- Idx [insertArc](#) (Idx site, const CoordT &sweep\_line\_y)
- void [removeArc](#) (Idx arc\_id)
- Idx [getLeftArc](#) (Idx arc\_id)
- Idx [getRightArc](#) (Idx arc\_id)
- Idx [getLeftmostArc](#) ()  
*Returns the ID of the leftmost arc, or nil\_idx if the beach line is empty.*
- Idx [getRightmostArc](#) ()  
*Returns the ID of the rightmost arc, or nil\_idx if the beach line is empty.*
- Idx [getOriginSite](#) (Idx arc\_id)

#### 3.7.1 Detailed Description

```
template<typename PolicyT>class frivol::fortune::BeachLine< PolicyT >
```

The advancing sweepline of Fortune's algorithm. Consists of parabolic arcs that are defined to be the curves that have equal distances from an input site and from the sweepline. Adjacent arcs are separated by their intersection points called breakpoints.

The arcs of the beach line are identified by numerical arc IDs. The maximum number of arcs in the beach line must be specified in advance.

#### Template Parameters

<i>PolicyT</i>	The algorithm policy to use, instance of <a href="#">Policy</a> template.
----------------	---

#### 3.7.2 Constructor & Destructor Documentation

- 3.7.2.1 `template<typename PolicyT > frivol::fortune::BeachLine< PolicyT >::BeachLine ( const containers::Array< PointT > & sites, Idx max_arcs )`

Constructs [BeachLine](#).

## Parameters

<i>sites</i>	The input sites for the algorithm.
<i>max_arcs</i>	The number of arcs the beach line must be able to contain.

## 3.7.3 Member Function Documentation

3.7.3.1 `template<typename PolicyT> Idx frivol::fortune::BeachLine< PolicyT >::getLeftArc ( Idx arc_id )`

Returns the ID of the arc left from given arc.

## Parameters

<i>arc_id</i>	ID of the arc.
---------------	----------------

## Returns

arc ID of the arc to the left from *arc\_id*, or *nil\_idx* if *arc\_id* is the leftmost arc.

3.7.3.2 `template<typename PolicyT> Idx frivol::fortune::BeachLine< PolicyT >::getMaxArcCount ( ) const`

Gets the maximum number of arcs there can be in the beach line. The arc IDs are in 0, ..., [getMaxArcCount\(\)](#)-1.

3.7.3.3 `template<typename PolicyT> Idx frivol::fortune::BeachLine< PolicyT >::getOriginSite ( Idx arc_id )`

Returns the index of the origin site of given arc.

## Parameters

<i>arc_id</i>	ID of the arc.
---------------	----------------

3.7.3.4 `template<typename PolicyT> Idx frivol::fortune::BeachLine< PolicyT >::getRightArc ( Idx arc_id )`

Returns the ID of the arc right from given arc.

## Parameters

<i>arc_id</i>	ID of the arc.
---------------	----------------

## Returns

arc ID of the arc to the right from *arc\_id*, or *nil\_idx* if *arc\_id* is the rightmost arc.

3.7.3.5 `template<typename PolicyT> Idx frivol::fortune::BeachLine< PolicyT >::insertArc ( Idx site, const CoordT & sweepline_y )`

Adds arc to the right place in the beach line. If the beach line is nonempty, the arc under the new arc is split split in two, so that the original arc is on the right from the new arc and an additional arc is created to the left from the new arc.

## Parameters

<i>site</i>	The origin site of the arc. The arc is placed in the position of the X-coordinate of the site.
<i>sweepline_y</i>	The Y-coordinate of the sweep line that defines the parabolas.

**Returns**

the ID of the new arc.

**Exceptions**

<code>std::logic_error</code>	if the maximum number of arcs ( <a href="#">getMaxArcCount()</a> ) are already in use.
-------------------------------	--

### 3.7.3.6 `template<typename PolicyT > void frivol::fortune::BeachLine< PolicyT >::removeArc ( Idx arc_id )`

Removes arc from the beach line.

**Parameters**

<code>arc_id</code>	The ID of the arc to remove.
---------------------	------------------------------

The documentation for this class was generated from the following files:

- /home/topi/coodaus/emscripten\_share/frivol/frivol/fortune/beach\_line.hpp
- /home/topi/coodaus/emscripten\_share/frivol/frivol/fortune/beach\_line\_impl.hpp

## 3.8 frivol::containers::priority\_queues::BinaryHeap< PriorityT > Class Template Reference

Implementation of [PriorityQueueConcept](#) using a binary heap.

```
#include <binary_heap.hpp>
```

**Public Member Functions**

- **BinaryHeap** (Idx size)
- `std::pair< Idx, PriorityT > pop ()`
- `bool empty () const`
- `void setPriority` (Idx key, PriorityT priority)
- `void setPriorityNIL` (Idx key)

The documentation for this class was generated from the following files:

- /home/topi/coodaus/emscripten\_share/frivol/frivol/containers/priority\_queues/binary\_heap.hpp
- /home/topi/coodaus/emscripten\_share/frivol/frivol/containers/priority\_queues/binary\_heap\_impl.hpp

## 3.9 frivol::containers::priority\_queues::DummyPriorityQueue< PriorityT > Class Template Reference

Simple implementation of [PriorityQueueConcept](#).

```
#include <dummy_priority_queue.hpp>
```

**Public Member Functions**

- **DummyPriorityQueue** (Idx size)

- `std::pair< Idx, PriorityT > pop ()`
- `bool empty () const`
- `void setPriority (Idx key, PriorityT priority)`
- `void setPriorityNIL (Idx key)`

The documentation for this class was generated from the following files:

- `/home/topi/coodaus/emscripten_share/frivol/frivol/containers/priority_queues/dummy_priority_queue.hpp`
- `/home/topi/coodaus/emscripten_share/frivol/frivol/containers/priority_queues/dummy_priority_queue_impl.hpp`

### 3.10 `frivol::containers::search_trees::DummySearchTree< ElementT >` Class Template Reference

Simple implementation of [SearchTreeConcept](#) (a wrapper around `std::list`).

```
#include <dummy_search_tree.hpp>
```

#### Public Types

- `typedef std::list< ElementT >::iterator Iterator`

#### Public Member Functions

- `template<typename FuncT > Iterator search (FuncT func)`

The documentation for this class was generated from the following file:

- `/home/topi/coodaus/emscripten_share/frivol/frivol/containers/search_trees/dummy_search_tree.hpp`

### 3.11 `frivol::containers::DynamicArray< T >` Class Template Reference

```
#include <dynamic_array.hpp>
```

#### Public Member Functions

- `DynamicArray ()`  
*Creates a dynamic array of size 0.*
- `DynamicArray (Idx size)`
- `Idx getSize () const`  
*Returns the size of the array.*
- `Idx add (const T &element)`
- `const T & operator[] (Idx index) const`
- `T & operator[] (Idx index)`

### 3.11.1 Detailed Description

template<typename T> class frivol::containers::DynamicArray< T >

[Array](#) that is more efficient at adding elements to the end than a regular array because [DynamicArray](#) constructs more elements in advance.

#### Template Parameters

<i>T</i>	The type of stored elements. Should be default constructible.
----------	---

### 3.11.2 Constructor & Destructor Documentation

3.11.2.1 template<typename T> frivol::containers::DynamicArray< T >::DynamicArray ( *Idx size* )

Creates a dynamic array with all elements default-constructed.

#### Parameters

<i>size</i>	The size of the array.
-------------	------------------------

### 3.11.3 Member Function Documentation

3.11.3.1 template<typename T> *Idx* frivol::containers::DynamicArray< T >::add ( const T & *element* )

Adds given element to the end of the dynamic array, increasing its size by one.

#### Parameters

<i>element</i>	The element to add.
----------------	---------------------

#### Returns

the index of the added element.

3.11.3.2 template<typename T> const T & frivol::containers::DynamicArray< T >::operator[] ( *Idx index* ) const

Returns reference to an element in the array.

#### Parameters

<i>index</i>	The zero-based index of the element.
--------------	--------------------------------------

#### Exceptions

<i>std::out_of_range</i>	if FRIVOL_ARRAY_BOUNDS_CHECKING is defined and 'index' overflows.
--------------------------	---

3.11.3.3 template<typename T> T & frivol::containers::DynamicArray< T >::operator[] ( *Idx index* )

Returns reference to an element in the array.

#### Parameters

<i>index</i>	The zero-based index of the element.
--------------	--------------------------------------

**Exceptions**

<i>std::out_of_range</i>	if FRIVOL_ARRAY_BOUNDS_CHECKING is defined and 'index' overflows.
--------------------------	---

The documentation for this class was generated from the following files:

- /home/topi/coodaus/emscripten\_share/frivol/frivol/containers/dynamic\_array.hpp
- /home/topi/coodaus/emscripten\_share/frivol/frivol/containers/dynamic\_array\_impl.hpp

**3.12 frivol::GeometryTraits< CoordT > Struct Template Reference**

```
#include <geometry_traits.hpp>
```

**3.12.1 Detailed Description**

```
template<typename CoordT>struct frivol::GeometryTraits< CoordT >
```

Traits class that gives needed geometry operations for the algorithm. Implemented traits are required by [Policy](#).

**Template Parameters**

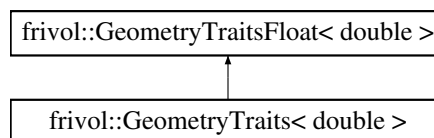
<i>CoordT</i>	The coordinate type to use.
---------------	-----------------------------

The documentation for this struct was generated from the following file:

- /home/topi/coodaus/emscripten\_share/frivol/frivol/geometry\_traits.hpp

**3.13 frivol::GeometryTraits< double > Struct Template Reference**

Inheritance diagram for frivol::GeometryTraits< double >:

**Additional Inherited Members**

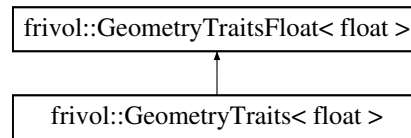
The documentation for this struct was generated from the following file:

- /home/topi/coodaus/emscripten\_share/frivol/frivol/geometry\_traits.hpp

**3.14 frivol::GeometryTraits< float > Struct Template Reference**

Inheritance diagram for frivol::GeometryTraits< float >:





### Additional Inherited Members

The documentation for this struct was generated from the following file:

- /home/topi/coodaus/emscripten\_share/frivol/frivol/geometry\_traits.hpp

## 3.15 frivol::GeometryTraitsFloat< CoordT > Struct Template Reference

```
#include <geometry_traits.hpp>
```

### Public Types

- typedef [Point](#)< CoordT > **PointT**

### Static Public Member Functions

- static CoordT **getBreakpointX** (const [PointT](#) &a, const [PointT](#) &b, CoordT topy, bool positive\_big)
- static [PointT](#) **getCircumcenter** (const [PointT](#) &a, const [PointT](#) &b, const [PointT](#) &c)
- static CoordT **getCircumcircleTopY** (const [PointT](#) &a, const [PointT](#) &b, const [PointT](#) &c)
- static bool **isCCW** (const [PointT](#) &a, const [PointT](#) &b, const [PointT](#) &c)

### Static Public Attributes

- static constexpr CoordT **epsilon** = 1e-30

#### 3.15.1 Detailed Description

```
template<typename CoordT>struct frivol::GeometryTraitsFloat< CoordT >
```

Implementation of [GeometryTraits](#) for floating point coordinate types (float and double).

The documentation for this struct was generated from the following files:

- /home/topi/coodaus/emscripten\_share/frivol/frivol/geometry\_traits.hpp
- /home/topi/coodaus/emscripten\_share/frivol/frivol/geometry\_traits\_impl.hpp

## 3.16 frivol::GeometryTraitsImplementedConcept< CoordT > Class Template Reference

```
#include <geometry_traits.hpp>
```

### 3.16.1 Detailed Description

```
template<typename CoordT>class frivol::GeometryTraitsImplementedConcept< CoordT >
```

Concept for checking that all required [GeometryTraits](#) are implemented for given coordinate type. Required operations are:

- `CoordT getBreakpointX( Point<CoordT> a, Point<CoordT> b, CoordT topy, bool positive_big)` returns the X coordinate of intersection of the two parabolas defined by  $(x-a.x)^2 + (y-a.y)^2 = (y-topy)^2 = (x-b.x)^2 + (y-b.y)^2$ . The function may assume that  $a.x \leq b.x$ ,  $a.y \leq topy$  and  $b.y \leq topy$ . The function should choose the solution where the parabola around a goes under the parabola around b. In cases where this does not happen, the result should be very big number, positive if `positive_big`, otherwise negative.
- `Point<CoordT> getCircumcenter(Point<CoordT> a, Point<CoordT> b, Point<CoordT> c)` returns the center point of the circumscribed circle around triangle 'abc'.
- `CoordT getCircumcircleTopY(Point<CoordT> a, Point<CoordT> b, Point<CoordT> c)` returns the Y coordinate of the top point (i.e. highest Y coordinate) of the circumscribed circle around triangle 'abc'.
- `bool isCCW(Point<CoordT> a, Point<CoordT> b, Point<CoordT> c)` returns true if triangle 'abc' is oriented counterclockwise.

#### Template Parameters

<i>CoordT</i>	The coordinate type.
---------------	----------------------

The documentation for this class was generated from the following file:

- `/home/topi/coodaus/emscripten_share/frivol/frivol/geometry_traits.hpp`

## 3.17 frivol::Point< CoordT > Struct Template Reference

```
#include <point.hpp>
```

### Public Member Functions

- [Point](#) (CoordT *x*, CoordT *y*)
  - [Point](#) ()
- Constructs point with undefined values as coordinates.*

### Public Attributes

- CoordT *x*
- The X coordinate of the point.*
- CoordT *y*
- The Y coordinate of the point.*

### 3.17.1 Detailed Description

```
template<typename CoordT = double>struct frivol::Point< CoordT >
```

Two-dimensional point.

## Template Parameters

<i>CoordT</i>	The coordinate type to use. Should be default constructible. Defaults to double, which is the coordinate type of DefaultPolicy.
---------------	---

## 3.17.2 Constructor &amp; Destructor Documentation

3.17.2.1 `template<typename CoordT = double> frivol::Point< CoordT >::Point ( CoordT x, CoordT y ) [inline]`

Constructs point with given coordinates.

## Parameters

<i>x</i>	The X coordinate.
<i>y</i>	The Y coordinate.

The documentation for this struct was generated from the following file:

- /home/topi/coodaus/emscripten\_share/frivol/frivol/point.hpp

## 3.18 frivol::Policy&lt; CoordT, EventPriorityQueueT, BeachLineSearchTreeT &gt; Struct Template Reference

```
#include <policy.hpp>
```

## Public Types

- typedef CoordT **Coord**

## 3.18.1 Detailed Description

```
template<typename CoordT, template< typename PriorityT > class EventPriorityQueueT, template< typename ElementT > class BeachLineSearchTreeT> struct frivol::Policy< CoordT, EventPriorityQueueT, BeachLineSearchTreeT >
```

[Policy](#) class for the Fortune's algorithm, specifying data types and data structures to use.

## Template Parameters

<i>CoordT</i>	The coordinate type to use. Should be ordered and default constructible to undefined value. Should have specialization of <a href="#">GeometryTraits</a> .
<i>EventQueueT</i>	The priority queue type for events. Must conform to PriorityQueueConcept.
<i>BeachLineT</i>	The search tree to use for the "beach line" of arcs. Must conform to SearchTreeConcept.

The documentation for this struct was generated from the following file:

- /home/topi/coodaus/emscripten\_share/frivol/frivol/policy.hpp

## 3.19 frivol::containers::PriorityQueueConcept&lt; X, PriorityT &gt; Class Template Reference

```
#include <priority_queue_concept.hpp>
```

### 3.19.1 Detailed Description

```
template<typename X, typename PriorityT> class frivol::containers::PriorityQueueConcept< X, PriorityT >
```

Concept checking class for priority queues X with priority values of type PriorityT (or NIL). Priority queues are initialized with given size, and contain priority values for keys 0, 1, ..., size-1. Initially, all priority values are NIL. X must support the following operations:

- `<construct>(Idx size)` creates priority queue for keys 0, 1, ..., size-1.
- `bool empty()` const returns true if all keys have NIL priority.
- `std::pair<Idx, PriorityT> pop()` returns pair of a key with lowest non-NIL priority and its priority and sets the priority to NIL.
- `void setPriority(Idx key, PriorityT priority)` sets the priority value of 'key' to non-NIL value 'priority'.
- `void setPriorityNIL(Idx key)` sets the priority value of key 'key' to NIL.

X may assume that PriorityT is ordered with `<-operator`. X may have undefined behavior if supplied keys are out of range or if `pop()` is called when `empty()` returns true.

The documentation for this class was generated from the following file:

- `/home/topi/coodaus/emscripten_share/frivol/frivol/containers/priority_queue_concept.hpp`

## 3.20 frivol::containers::SearchTreeConcept< X, ElementT > Class Template Reference

```
#include <search_tree_concept.hpp>
```

### Public Types

- `typedef X::Iterator` **IteratorT**

### 3.20.1 Detailed Description

```
template<typename X, typename ElementT> class frivol::containers::SearchTreeConcept< X, ElementT >
```

Concept checking class for search trees X for elements of type ElementT. Search trees are sequence containers, the elements of which are iterated using iterator objects of type X::Iterator. The iterator must be a standard bidirectional iterator. X must support the following operations:

- `<construct>()` creates empty search tree.
- `bool empty()` const returns true if the search tree is empty.
- `Iterator begin()` returns the iterator of the first element (or past-the-end if empty).
- `Iterator end()` returns the iterator past the last element.
- `template<typename FuncT> Iterator search(FuncT func)` searches the sequence using the supplied `int(-Iterator)-function` that for given iterator `iter` returns negative if the searched element is before `iter`, positive if it is after `iter`, and 0 if `iter` is the right element. If an element such that `func` returns 0 is found, it is returned, otherwise `end()` is returned.
- `void erase(Iterator iter)` removes element at `iter`. Other iterators should not be invalidated.
- `Iterator insert(Iterator iter, const ElementT& elem)` inserts `elem` before `iter` and returns the iterator of the new element. Does not invalidate any iterators.

X may assume that ElementT is copy constructible.

The documentation for this class was generated from the following file:

- /home/topi/coodaus/emscripten\_share/frivol/frivol/containers/search\_tree\_concept.hpp

## 3.21 frivol::containers::Stack< T > Class Template Reference

```
#include <stack.hpp>
```

### Public Member Functions

- [Stack](#) ()  
*Constructs empty stack.*
- bool [empty](#) () const  
*Returns true if the stack is empty.*
- T & [top](#) ()
- void [pop](#) ()  
*Removes the top element of the stack. Call only if [empty\(\)](#) is false.*
- void [push](#) (const T &element)

### 3.21.1 Detailed Description

```
template<typename T> class frivol::containers::Stack< T >
```

[Stack](#) of elements. The container constructs elements in advance so they should be default-constructible.

#### Template Parameters

<i>T</i>	The type of stored elements.
----------	------------------------------

### 3.21.2 Member Function Documentation

3.21.2.1 `template<typename T> void frivol::containers::Stack< T >::push ( const T & element )`

Pushes element to the top of the stack.

#### Parameters

<i>element</i>	The element to push.
----------------	----------------------

3.21.2.2 `template<typename T> T & frivol::containers::Stack< T >::top ( )`

Returns reference to the top element of the stack. Call only if [empty\(\)](#) is false.

The documentation for this class was generated from the following files:

- /home/topi/coodaus/emscripten\_share/frivol/frivol/containers/stack.hpp
- /home/topi/coodaus/emscripten\_share/frivol/frivol/containers/stack\_impl.hpp

## 3.22 frivol::VoronoiDiagram< CoordT > Class Template Reference

```
#include <voronoi_diagram.hpp>
```

### Classes

- struct **Edge**

### Public Types

- typedef [Point](#)< CoordT > **PointT**

### Public Member Functions

- [VoronoiDiagram](#) (Idx faces)
- Idx [getFaceCount](#) () const  
*Returns the number of faces in the diagram.*
- Idx [getEdgeCount](#) () const  
*Returns the number of half-edges in the diagram.*
- Idx [getVertexCount](#) () const  
*Returns the number of Voronoi vertices in the diagram.*
- Idx [getFaceBoundaryEdge](#) (Idx face) const
- Idx [getTwinEdge](#) (Idx edge) const
- Idx [getIncidentFace](#) (Idx edge) const
- Idx [getStartVertex](#) (Idx edge) const
- Idx [getEndVertex](#) (Idx edge) const
- Idx [getNextEdge](#) (Idx edge) const
- Idx [getPreviousEdge](#) (Idx edge) const
- const [PointT](#) & [getVertexPosition](#) (Idx vertex) const
- std::pair< Idx, Idx > [addEdge](#) (Idx face1, Idx face2)
- Idx [addVertex](#) (const [PointT](#) &pos, Idx edge1, Idx edge2, Idx edge3)
- void [consecutiveEdges](#) (Idx edge1, Idx edge2)

### 3.22.1 Detailed Description

```
template<typename CoordT = double>class frivol::VoronoiDiagram< CoordT >
```

Structure for storing a Voronoi diagram. The diagram consists of faces (one for each input site), edges between faces and Voronoi vertices (the endpoints of edges).

One vertex is always incident to three edges - vertices with four or more incident edges can be achieved by using duplicate voronoi vertices and edges of length 0. Each edge is actually a pair half-edges (twin edges) that represent the sides of the edge. The half-edges are thought to be directed so that they cycle around a face counterclockwise.

The faces, half-edges and Voronoi vertices are identified by numerical IDs 0...count-1. The ID of the faces should be the same as their corresponding input site indices.

#### Template Parameters

<i>CoordT</i>	Coordinate type of the points stored in the Voronoi diagram.
---------------	--

### 3.22.2 Constructor & Destructor Documentation

3.22.2.1 `template<typename CoordT > frivol::VoronoiDiagram< CoordT >::VoronoiDiagram ( Idx faces )`

Constructs Voronoi diagram.

## Parameters

<i>faces</i>	Number of faces.
--------------	------------------

## 3.22.3 Member Function Documentation

3.22.3.1 `template<typename CoordT > std::pair< Idx, Idx > frivol::VoronoiDiagram< CoordT >::addEdge ( Idx face1, Idx face2 )`

Adds a new edge (two twin half-edges) to the Voronoi diagram.

## Parameters

<i>face1, face2</i>	The IDs of the faces incident to the edge.
---------------------	--

## Returns

the IDs of the new half-edges, first one having face1 and the second one having face2 as incident face.

3.22.3.2 `template<typename CoordT > Idx frivol::VoronoiDiagram< CoordT >::addVertex ( const PointT & pos, Idx edge1, Idx edge2, Idx edge3 )`

Adds a new Voronoi vertex.

## Parameters

<i>pos</i>	Position of the vertex.
<i>edge1, edge2, edge3</i>	The half-edges having the new vertex as end vertex, in counterclockwise order.

## Returns

the ID of the new vertex.

3.22.3.3 `template<typename CoordT > void frivol::VoronoiDiagram< CoordT >::consecutiveEdges ( Idx edge1, Idx edge2 )`

Mark half-edges as being consecutive. Done automatically by addVertex for non-infinite ends of edges.

## Parameters

<i>edge1, edge2</i>	The IDs of the half-edges such that edge2 should be next from edge1.
---------------------	--

3.22.3.4 `template<typename CoordT > Idx frivol::VoronoiDiagram< CoordT >::getEndVertex ( Idx edge ) const`

Returns the ID of the Voronoi vertex in the end of given half-edge. If the diagram is incomplete and the vertex has not yet been found, `nil_idx` is returned.

## Parameters

<i>edge</i>	ID of the half-edge.
-------------	----------------------

### 3.22.3.5 `template<typename CoordT > Idx frivol::VoronoiDiagram< CoordT >::getFaceBoundaryEdge ( Idx face ) const`

Returns the ID of a half-edge that is on the boundary of given face. If the diagram is incomplete and no such edges have been found or there is only one face, `nil_idx` is returned.

## Parameters

<i>face</i>	ID of the face that the half-edge should be incident to.
-------------	--

### 3.22.3.6 `template<typename CoordT > Idx frivol::VoronoiDiagram< CoordT >::getIncidentFace ( Idx edge ) const`

Returns the ID of the incident face of given half-edge.

## Parameters

<i>edge</i>	ID of the half-edge.
-------------	----------------------

### 3.22.3.7 `template<typename CoordT > Idx frivol::VoronoiDiagram< CoordT >::getNextEdge ( Idx edge ) const`

Returns the ID of the next half-edge around the incident face. If the diagram is incomplete and the next edge has not yet been found, `nil_idx` is returned.

## Parameters

<i>edge</i>	ID of the half-edge.
-------------	----------------------

### 3.22.3.8 `template<typename CoordT > Idx frivol::VoronoiDiagram< CoordT >::getPreviousEdge ( Idx edge ) const`

Returns the ID of the previous half-edge around the incident face. If the diagram is incomplete and the previous edge has not yet been found, `nil_idx` is returned.

## Parameters

<i>edge</i>	ID of the half-edge.
-------------	----------------------

### 3.22.3.9 `template<typename CoordT > Idx frivol::VoronoiDiagram< CoordT >::getStartVertex ( Idx edge ) const`

Returns the ID of the Voronoi vertex in the start of given half-edge. If the diagram is incomplete and the vertex has not yet been found, `nil_idx` is returned.

## Parameters

<i>edge</i>	ID of the half-edge.
-------------	----------------------

### 3.22.3.10 `template<typename CoordT > Idx frivol::VoronoiDiagram< CoordT >::getTwinEdge ( Idx edge ) const`

Returns the ID of the twin half-edge of given half-edge. Twin half-edges are the sides of an edge, having opposite directions.



## Parameters

<i>edge</i>	ID of the half-edge.
-------------	----------------------

3.22.3.11 `template<typename CoordT > const Point< CoordT > & frivol::VoronoiDiagram< CoordT >::getVertexPosition ( idx vertex ) const`

Returns the position of a Voronoi vertex.

## Parameters

<i>vertex</i>	ID of the Voronoi vertex.
---------------	---------------------------

The documentation for this class was generated from the following files:

- `/home/topi/coodaus/emscripten_share/frivol/frivol/voronoi_diagram.hpp`
- `/home/topi/coodaus/emscripten_share/frivol/frivol/voronoi_diagram_impl.hpp`